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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/600,039	06/20/2003	Oliver Chyan	122302.00001	6398
7590	07/05/2005		EXAMINER LE, DUNG ANH	
Michael G. Cameron Jackson Walker LLP Suite 600 2435 North Central Expressway Richardson, TX 75080			ART UNIT	PAPER NUMBER
			2818	

DATE MAILED: 07/05/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

<b>Office Action Summary</b>	Application No. 10/600,039	Applicant(s) CHYAN ET AL.	
	Examiner DUNG A LE	Art Unit 2818	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

#### Status

- 1) ☐ Responsive to communication(s) filed on \_\_\_\_.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

#### Disposition of Claims

- 4) ☒ Claim(s) 1-46 is/are pending in the application.
- 4a) Of the above claim(s) 11-24, 30 and 35-46 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-10, 25-29 and 31-34 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_ are subject to restriction and/or election requirement.

#### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

#### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- \* See the attached detailed Office action for a list of the certified copies not received.

#### Attachment(s)

- |   |  |
|---|--|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. ____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)  | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)            |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date <u>6/20/03</u> . | 6) <input type="checkbox"/> Other: ____  |

*Dk*

*DETAILED ACTION*

Applicants are reminded to cancelled non-elective claims.

37.CFR 1.131 Declaration by Oliver Chyan filed May 16, 2005 has been considered.

**Claim Rejections**

**Set of claim 1- 10**

**Claim Rejections - 35 USC § 103**

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

**Claims 1, 4, 6, 8 and 10 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Choi (5637533) in view of Hwang et al. (5618746).**

Choi teaches a method of controlling and containing copper 11 layer diffusion during the integration of copper interconnects during the fabrication of integrated circuits, comprising:

preparing an inter-level dielectric substrate 5;

Art Unit: 2818

depositing a layer of RuO<sub>2</sub> as a diffusion stuffer on the inter-level dielectric substrate ; and depositing copper on the RuO<sub>2</sub> layer.

Choi does not teach the step of depositing a layer of Ru on the inter-level dielectric substrate; depositing a layer of RuO<sub>2</sub> as a diffusion stuffer on the Ru layer.

Hwang et al. teach Ru 49a on the inter-level dielectric substrate 45; depositing a layer of RuO<sub>2</sub> as a diffusion stuffer 51 a on the Ru layer 49a (col 4, lines 40-50).

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to deposit a layer of Ru on the inter-level dielectric substrate; depositing a layer of RuO<sub>2</sub> as a diffusion stuffer on the Ru layer. in Mr. Choi 's method, in order to employ the ruthenium film as a diffusion-blocking film that has a high conductivity and prevents silicon diffusion. Thus, a larger electrostatic capacity can be obtained in a smaller effective area. As a result, a semiconductor memory device can be highly integrated and product reliability can be enhanced. (col 3, lines 25-30).

**Regarding claim 4**, further comprising depositing the RuO<sub>2</sub> layer(s) on the Ru layer(s) using a thermal oxidation technique (col 2, lines 43).

**Regarding claim 6**, further comprising depositing the RuO<sub>2</sub> layer(s) on

the Ru layer(s) using physical vapor deposition. (col 1, line 17)

**Regarding claim 8**, further comprising depositing the RuO<sub>2</sub> layer on the Ru layer using a thermal oxidation technique (col 2, lines 40-45).

**Regarding claim 10** further comprising depositing the RuO<sub>2</sub> layer on the Ru layer using physical vapor deposition (col 1, line 17).

**Claims 2, 3, 5, 7 and 9 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Choi (5637533) in view of Hwang et al. (5618746) and further in view of the following remark.**

**Regarding claim 2**, Choi in view of Hwang discloses the claimed invention except for depositing multiple layers of Ru and RuO<sub>2</sub> between the inter-level dielectric substrate and the copper layer.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to form multiple layers of Ru and RuO<sub>2</sub> between the inter-level dielectric substrate and the copper layer, since it has been held that mere duplication of the essential working parts of a device involves only routine skill in the art.

**Regarding claims 3, 5, 7 and 9**, Choi in view of Hwang disclose the claimed invention as applied to claim 1, except that depositing the RuO<sub>2</sub> layer on the inter-level dielectric using an atomic layer technique and depositing the RuO<sub>2</sub> layer on the inter-

Art Unit: 2818

level dielectric using an electrochemical technique instead of depositing the RuO<sub>2</sub> layer on the inter-level dielectric using a thermal oxidation technique (col 2, lines 40-45) and depositing the RuO<sub>2</sub> layer on the inter-level dielectric using a physical vapor technique (col 1, line 17).

Therefore, because the claimed depositing steps were art-recognized equivalents at the time the invention was made, one of ordinary skill in the art would have found it obvious to substitute the steps of depositing the RuO<sub>2</sub> layer on the inter-level dielectric using an atomic layer technique and depositing the RuO<sub>2</sub> layer on the inter-level dielectric using an electrochemical technique for the particular application in which they are employed.

### **Set of claims 25- 29**

#### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

**Claims 25, 28- 29 are rejected under 35 USC 102 (b) as being anticipated by Choi (5637533) .**

Choi teaches a method of controlling and containing copper diffusion during the integration of copper interconnects during the fabrication of integrated circuits, comprising: preparing an inter-level dielectric substrate 1; depositing one or a plurality of layers of RuO<sub>2</sub> 10 on the inter-level dielectric substrate; and depositing copper 11 on the RuO<sub>2</sub> layer.

**Regarding claim 28**, further comprising depositing the RuO<sub>2</sub> layer on the inter-level dielectric using a thermal oxidation technique (col 2, lines 40-45).

**Regarding claim 29**, further comprising depositing the RuO<sub>2</sub> layer on the inter-level dielectric using a physical vapor technique (col 1, line 17).

### **Claim Rejections - 35 USC § 103**

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

**Claims 26- 27 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Choi (5637533) in view of the following remark.**

Choi discloses the claimed invention as applied to claim 25, except that depositing the RuO<sub>2</sub> layer on the inter-level dielectric using an atomic layer technique and depositing the RuO<sub>2</sub> layer on the inter-level dielectric using an electrochemical technique instead of depositing the RuO<sub>2</sub> layer on the inter-level dielectric using a thermal oxidation technique (col 2, lines 40-45) and depositing the RuO<sub>2</sub> layer on the inter-level dielectric using a physical vapor technique (col 1, line 17).

Therefore, because the claimed depositing steps were art-recognized equivalents at the time the invention was made, one of ordinary skill in the art would have found it obvious to substitute the steps of depositing the RuO<sub>2</sub> layer on the inter-level dielectric using an atomic layer technique and depositing the RuO<sub>2</sub> layer on the inter-level dielectric using an electrochemical technique for the particular application in which they are employed.

### **Set of claims 31-32**

#### ***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.



**Claims 31- 32 are rejected under 35 USC 102 (b) as being anticipated by Iwasaki et al. (6624513 B1).**

Iwasaki et al. teach a method of controlling copper 23/17 diffusion during the integration of copper interconnects during integrated circuit fabrication, comprising using Ru as a diffusion barrier 14/16/19/22a/22b/22c (col 11, line 25 and col 12, lines 32-43, figs: 16-17).

**Regarding claim 32, eliminating a copper seed layer (col 12, line 40-42).**

**Set of claims 33- 34.**

***Claim Rejections - 35 USC § 102***

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless --

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

**Claims 33-34 are rejected under 35 USC 102 (b) as being anticipated by Iwasaki et al. (6,624,513).**

Iwasaki et al. teach a method of controlling copper diffusion during the integration of copper interconnects during integrated circuit fabrication, comprising using Ru and RuO<sub>2</sub> as a diffusion barrier (col 12 , lines 32-62).

**Regarding claim 34**, further comprising eliminating a copper seed layer (col 12, line 40).

When responding to the office action, Applicants' are advice to provide the examiner with the line numbers and page numbers in the application and/or references cited to assist the examiner to locate the appropriate paragraphs.


A shortened statutory period for response to this action is set to expire 3 (three) months and 0 (zero) day from the day of this letter. Failure to respond within the period for response will cause the application to become abandoned (see M.P.E.P 710.02(b)).

### **Conclusion**

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Dung A. Le whose telephone number is (571) 272-1784. The examiner can normally be reached on Monday-Tuesday and Thursday 6:00am- 4:00 pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Nelms can be reached on (571) 272-1787. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9306 for regular communications and (703) 872-9306 for After Final communications.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

DUNG A. LE   
Primary Examiner  
Art Unit 2818